

The goatfish *Mulloidichthys mimicus* n. sp. (Pisces, Mullidae)
from Oceania, a mimic of the snapper *Lutjanus kasmira*
(Pisces, Lutjanidae)

by John E. RANDALL and Paul GUÉZÉ *

Abstract. — The goatfish *Mulloidichthys mimicus* is described as new from specimens from the Marquesas Islands and Line Islands. It is most closely related to the wide-ranging *M. vanicolensis*, differing in having 7-8 + 21-23 gill rakers compared to 8-10 + 23-26 for *vanicolensis*, greater body depth, and an average of one more lateral-line scale. In life it is yellow with blue stripes, almost the identical color pattern of the snapper *Lutjanus kasmira*. It was observed to school with this snapper and is believed to be a mimic of it. The basis for the mimicry may be a predator preference for a mullid fish over a lutjanid.

Résumé. — L'espèce nouvelle *Mulloidichthys mimicus* est décrite à partir d'exemplaires originaires des îles Marquises et Line. Elle est très proche de l'espèce à vaste répartition *M. vanicolensis* dont elle diffère par le nombre des branchiospines (7-8 + 21-23 contre 8-10 + 23-26), le corps plus élevé et une écaille de plus en moyenne sur la ligne latérale. Sur le vivant, elle est jaune rayée de bleu, coloration presque identique à celle de *Lutjanus kasmira*. Elle s'intègre aux bancs de ce Lutjan ; il s'agirait d'un cas de mimicrie dont la cause peut être la préférence d'un prédateur pour un *Mulloidichthys* plutôt que pour un *Lutjanus*.

In October-November of 1968 the senior author collected fishes in the Line Islands, Central Pacific. He noted a striking example of mimicry involving a goatfish, then believed to be *Mulloidichthys bilineatus* Valenciennes in Cuvier and Valenciennes (as identified by FOWLER, 1927; 1928 from a specimen from Palmyra) and the snapper *Lutjanus kasmira* (Forsskål). Like the colorful snapper, the goatfish is yellow with blue stripes and was observed to school with it. Small individuals aggregated with small snappers, and large ones with larger snappers. Six specimens of the goatfish were speared at Washington Island.

In May, 1971, the same association was observed in the Marquesas Islands. More specimens of the goatfish were obtained, and underwater photos taken, one of which is reproduced herein as Plate I, A (funds for Plate I provided by the Charles Engelhard Foundation). Field work in the Marquesas was supported by a grant from the National Geographic Society. A brief mention of the goatfish-snapper mimicry was made in a report to the Society (RANDALL, 1978).

* J. E. RANDALL, Senior Ichthyologist, Bernice P. Bishop Museum, Box 19000-A, Honolulu, Hawaii 96819.

P. GUÉZÉ, Correspondant du Muséum, Laboratoire d'Ichtyologie générale et appliquée, Muséum national d'Histoire naturelle, 43, rue Cuvier, 75231 Paris, Cedex 05.

Later we discovered that FOWLER's identification of the goatfish as *Mulloidichthys bilineatus* is erroneous (actually, FOWLER placed this species in the genus *Upeneus*, but LACHNER in SCHULTZ and collaborators, 1960, suspected it was a *Mulloidichthys*). This fish represents a new species related to *M. vanicolensis* Valenciennes in Cuvier and Valenciennes (*M. auriflamma* non Forsskål of many recent authors). The purpose of the present paper is to provide the description and to discuss the mimicry.

The holotype and eight paratypes are deposited in the Bernice P. Bishop Museum, Honolulu (BPBM). Other paratypes have been placed in the California Academy of Sciences, San Francisco (CAS), Muséum national d'Histoire naturelle, Paris (MNHN), and the U. S. National Museum of Natural History, Washington D.C. (USNM).

In the description of the new species, data in parentheses refer to paratypes. Measurements in Table 1 are given as a percentage of the standard length (SL). More data are presented in this table than are summarized in the text.

TABLE 1. — Proportional measurements of type specimens of *Mulloidichthys mimicus*, expressed as a percentage of the standard length.

	HOLOTYPE	PARATYPES					
	BPBM 12638	USNM 220029	CAS 44204	BPBM 12135	BPBM 4079	BPBM 7738	BPBM 7738
Standard length (mm)	204.0	140.3	145.0	169.6	188.0	211.0	253.0
Depth of body	31.4	31.0	30.7	28.3	29.4	29.1	28.5
Width of body	17.1	16.3	15.3	16.2	14.4	17.6	16.2
Head length	31.5	30.6	29.9	29.2	29.5	29.1	30.8
Snout length	14.1	12.8	12.8	13.1	12.8	13.2	13.9
Orbit diameter	7.9	8.1	8.0	6.8	6.7	7.1	7.2
Interorbital width	8.7	9.0	8.8	8.8	8.3	9.2	8.7
Maxillary length	11.0	10.1	10.2	10.6	10.3	10.1	11.2
Barbel length	23.0	21.0	21.2	21.3	21.6	21.6	21.5
Least depth of caudal peduncle	10.6	11.1	11.0	10.6	10.9	11.0	10.3
Length of caudal peduncle	22.8	23.2	22.8	21.8	22.6	23.8	21.1
Snout to origin of first dorsal fin	42.0	41.3	40.0	39.1	38.6	39.4	41.5
Snout to origin of second dorsal fin	68.2	67.7	65.5	65.0	64.7	66.4	68.1
Snout to origin of anal fin	68.3	64.1	66.2	65.6	65.4	66.4	66.8
Snout to origin of pelvic fins	34.1	32.8	33.9	33.5	31.4	31.7	34.2
Base of first dorsal fin	20.6	22.9	20.9	22.3	21.8	23.0	22.1
Base of second dorsal fin	15.6	15.6	15.2	14.3	14.1	15.5	15.3
Base of anal fin	11.7	12.1	11.7	12.4	11.5	12.0	11.8
Longest dorsal spine	20.1	20.2	26.7	23.0	21.2	20.3	19.5
Longest dorsal soft ray	12.9	13.5	14.1	13.9	13.1	13.8	13.6
Longest anal soft ray	12.4*	14.0	15.0	13.3	13.8	13.9	14.1
Caudal fin	26.2	28.3	28.3	26.5	damaged	24.6	25.7
Caudal concavity	13.5	14.5	15.9	13.6	damaged	12.4	14.6
Pectoral fin	20.6	20.4	20.3	20.0	19.5	19.4	20.1
Pelvic fin	20.1	21.3	22.6	21.0	20.2	21.0	19.9

* Tip of ray appears cut off.

Lateral-line scale counts begin with the first pored scale completely posterior to the upper end of the gill opening and end at the base of the caudal fin (three pored scales continue onto the caudal base). Counts of gill rakers were made on the first gill arch; they include all rudiments. The upper-limb counts are given first; the raker at the angle is contained in the lower-limb count. The depth of the body is the maximum depth excluding the fins. The width of the body was measured just posterior to the gill opening. The orbit diameter is the fleshy diameter, whereas the interorbital width is the bony width. The length of the caudal peduncle is the horizontal distance between the rear base of the anal fin and the caudal fin base. Caudal concavity is the horizontal distance between verticals at the distal ends of the shortest and longest caudal fin rays.

Mulloidichthys mimicus n. sp.

(Pl. I B)

Upeneus bilineatus Fowler (non Valenciennes), 1927. *Bull. B. P. Bishop Mus.*, **38** : 17, fig. 2 (Palmyra, Line Islands).

Upeneus bilineatus Fowler (non Valenciennes), 1928. *Mem. B. P. Bishop Mus.*, **10** : 233, fig. 47.

Parupeneus bilineatus Herre (non Valenciennes), 1936. *Fld. Mus. Nat. Hist.*, Zool. Ser., **21** : 213, fig. 11 (Nuku Hiva, Marquesas Islands).

Upeneus sulphureus Bagnis, Mazellier, Bennett, and Christian (non Valenciennes), 1972. *Poissons de Polynésie* : 260, fig. on same page (shows school of *M. mimicus* with one *Lutjanus kasmira* lower right) (Marquesas Islands).

Mulloidichthys sp. Plessis and Maugé, 1978. *Cah. Pacif.*, **21** : 224 (Marquesas).

HOLOTYPE : BPBM 12638, 204 mm SL, female, Marquesas Islands, Nuku Hiva, Sentinelle de l'Est, west side of islet, 15 m, spear, John E. RANDALL, 18 May 1971.

PARATYPES : BPBM 4079, 188 mm SL, Line Islands, Palmyra, Whippoorwill Expedition, 20 August 1924; MNHN 1966-75, 215 mm SL, Marquesas Islands, Ua Pou, Hakahau, Henri LAVONDÈS, March-April 1965; BPBM 7738, 6 : 211-248 mm SL, Line Islands, Washington; wreck of "Southbank" at west end of island, 6 to 7.5 m, spear, John E. RANDALL, 6 November 1968; BPBM 11901, 80.7 mm SL, Marquesas Islands, Tahuata, off point at south end of Vaitahu Bay, 18 m, spear, Dean B. CANNOY, 23 April 1971; BPBM 12135, 169.6 mm SL, Marquesas Islands, Ua Pou, Hakahetau Bay, south side, 6-11 m, spear, John E. RANDALL and Dean B. CANNOY, 28 April 1971; CAS 44204, 145 mm SL, MNHN 1974-78, 160 mm SL, and USNM 220029, 140.3 mm SL, same data as preceding.

DESCRIPTION

Dorsal rays VIII (the first minute)-9 (the first unbranched, the last branched to base); anal rays I, 7 (the first spine minute, the first ray unbranched, the last branched to base); pectoral rays 17 (16 or 17), the upper 2 unbranched; pelvic rays I, 5; principal caudal rays 15 (upper and lower unbranched); lateral-line scales 38 (38 or 39); scales above lateral line to origin of dorsal fin 2 1/2; scales below lateral line to origin of anal fin 8 (the last 2 at origin of anal fin small); rows of scales on cheek 3; circumpeduncular scales 16; gill rakers 7 + 22 (7 or 8 + 21 to 23 — see Table 2); pseudobranch filaments 37 (26 to 41, tending to increase with age); branchiostegal rays 3; vertebrae 10 + 14.

Body elongate, the depth 3.2 (3.1-3.5) in standard length, and moderately compressed,

width 1.8 (1.7-2.0) in depth ; head length 3.2 (3.2-3.4) in SL ; snout 2.2 (2.2-2.4) in head ; eye moderate, the orbit diameter 3.9 (3.7-4.4) in head ; interorbital space convex, the bony width 3.6 (3.2-3.55) in head ; barbels reaching slightly posterior to a vertical at upper margin of preopercle, their length 1.4 (1.35-1.45) in head ; least depth of caudal peduncle 3.0 (2.7-3.0) in head.

Mouth small, the maxilla not approaching a vertical at front of orbit, the maxillary length 2.9 (2.75-3.0) in head ; mouth slightly oblique and slightly inferior ; small conical teeth in 2 rows in upper jaw (except posteriorly where the teeth are more nodular and occur in essentially 1 row) and 3 to 4 rows at front of lower jaw, narrowing to a single row posteriorly ; teeth in outer row at front of jaws slightly enlarged ; no teeth on roof of mouth ; tongue fused to floor of mouth.

Posterior nostril a narrow vertical slit covered by a membrane at level of center of eye next to edge of orbit ; anterior nostril a smaller elliptical opening about $\frac{2}{3}$ orbit diameter in front of eye. Gill membranes narrowly attached to isthmus. Longest gill filaments on first gill arch about $\frac{2}{3}$ orbit diameter ; longest gill raker on first arch about 2.3 in longest gill filaments.

A single stout flat spine at posterior edge of opercle at level of lower third of eye ; preopercular margin smooth.

Scales very finely ctenoid ; head fully scaled ; fins naked except base of caudal fin. Lateral line following contour of back ; pored scales of lateral line with many branched tubules.

Origin of first dorsal fin above fifth lateral-line scale ; second or third dorsal spines longest, 1.6 (1.3-1.6) in head ; origin of second dorsal fin above nineteenth lateral-line scale, slightly anterior to anus ; second dorsal soft ray longest, 2.4 (2.1-2.3) in head ; origin of anal fin below twentieth lateral-line scale ; anal spine minute ; second anal soft ray longest, 2.5 (2.1-2.3) in head ; caudal fin 3.8 (3.5-4.05) in SL, forked, the caudal concavity 2.2 (1.9-2.35) in head ; pectoral fins pointed, 1.5 (1.4-1.5) in head ; pelvic fins 1.6 (1.3-1.55) in head, their origin directly below upper base of pectoral fins ; pelvic spine about two-thirds length of longest (second) pelvic ray ; scaly process of pelvic fins well developed, half length of pelvic spine.

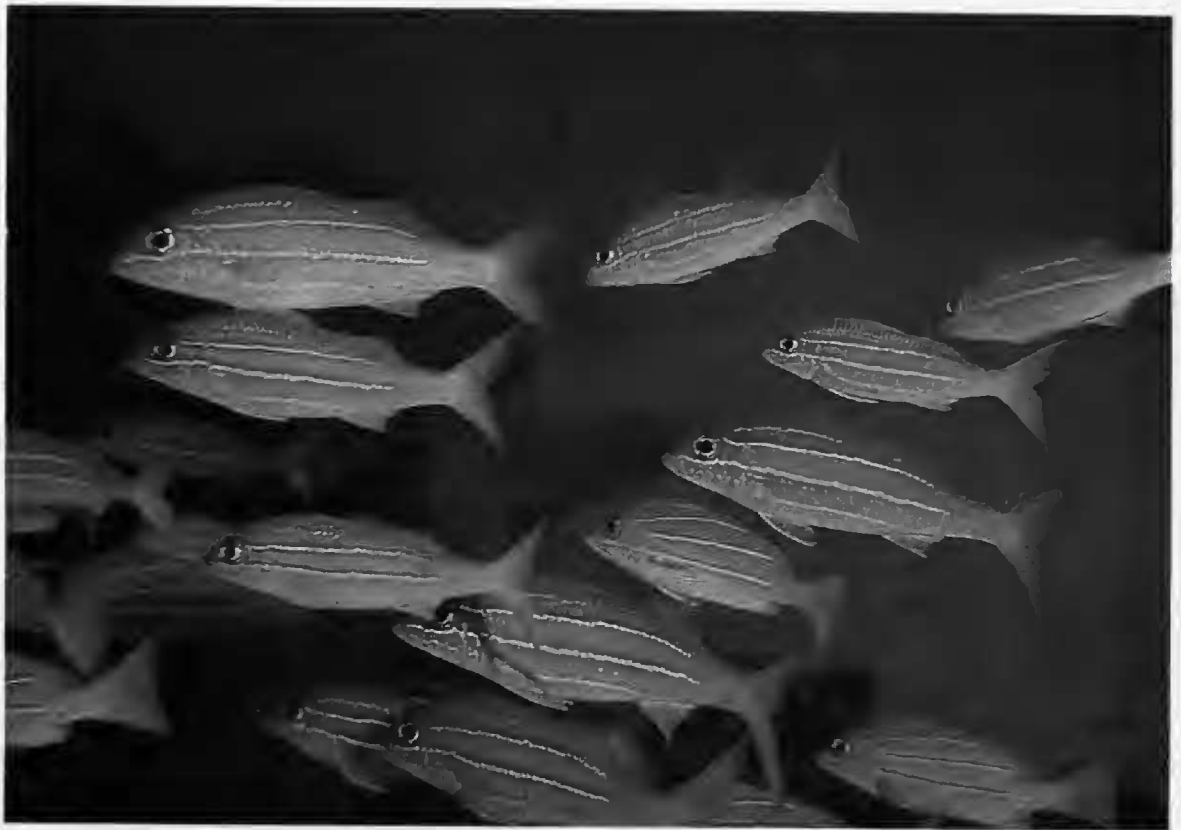
Color in alcohol pale with a broad diffuse mid-lateral dark stripe and three narrower faint dark stripes above this, the first beginning at level of upper edge of eye and following lateral line to below rear of first dorsal fin, then continuing posteriorly above lateral line ; second stripe beginning above posterior part of eye and following contour of back, becoming indistinct posterior to second dorsal fin ; uppermost dark stripe commencing on nape and passing along base of first dorsal fin ; a very faint dark stripe on upper abdomen at level of lower corner of pectoral base ; fins pale except a small amount of dusky pigment on membrane between second and third dorsal spines.

Color in life, yellow with blue stripes, as shown in Plate I.

REMARKS

Mulloidichthys mimicus is named for its resemblance to the snapper *Lutjanus kasmira* with which it was observed to school (see discussion below under MIMICRY).

Our specimens of this goatfish have come from the Line Islands and Marquesas Islands.



A. — Underwater photograph of a mixed school of *Mulloidichthys mimicus* and *Lutjanus kasmira* taken at Nuku Hiva, Marquesas Islands. Two of the *L. kasmira* may be seen in the lower right quarter of the photo (John E. Randall).



B. — Holotype of *Mulloidichthys mimicus*, 204 mm SL, Nuku Hiva, Marquesas Islands, BPBM 12638 (John. E. Randall).

We have not seen the species elsewhere. It certainly seems to be absent from such island groups as the Societies and Marshalls where much underwater observation and extensive fish collections have been made.

M. mimicus is most closely related to *M. vanicolensis* from which it differs in fewer gill rakers (Table 2), greater body depth (that of *vanicolensis* is 25 to 28 % SL), and an average of one more lateral-line scale (*vanicolensis* has 37 or 38, compared to 38 or 39 for *mimicus*).

TABLE 2. — Gill-raker counts of *Mulloidichthys mimicus* and *M. vanicolensis* from Pacific localities.

	UPPER LIMB				LOWER LIMB					
	7	8	9	10	21	22	23	24	25	26
<i>mimicus</i>	8	5			4	8	1			
<i>vanicolensis</i>		3	8	3			1	4	7	2

Curiously, *M. vanicolensis* has been observed at three different Indian Ocean localities in a strongly blue-striped color pattern similar to *mimicus*. On one occasion a school in the blue-striped form was seen to change the color pattern to one typical of *vanicolensis*. A solitary individual in the blue-striped pattern was collected by the senior author at Mafia Island, Tanzania (BPBM 17620, 156 mm SL) and another at Sri Lanka (BPBM 18770, 152 mm SL), thus the identification as *vanicolensis* could be confirmed. These fish were not in the company of *Lutjanus kasmira*. However, in March, 1980, the senior author observed a large school of adult *L. kasmira* in 10 m off Lamu, Kenya in which several *M. vanicolensis* of the same size were swimming. Underwater photos were taken. The goatfish had the same yellow ground color as *L. kasmira*, shading to white ventrally, and the stripes of the same brilliant blue, but they lacked a blue stripe dorsal to the one on the upper side at the level of the upper edge of the eye; so as mimics they are not as close to *L. kasmira* in color as *M. mimicus* which has a dorsal blue stripe (or row of confluent blue spots). Nevertheless, in the milling school of *L. kasmira*, the individual *M. vanicolensis* were difficult to perceive, and there is no doubt that mimicry is in effect. The comments below on the *M. mimicus* mimicry therefore apply to *M. vanicolensis* as well.

MIMICRY

RANDALL and RANDALL (1960) discussed the examples of mimicry among fishes known at that time. RUSSELL, ALLEN and LUBBOCK (1976) reviewed more recent cases of mimicry among marine fishes and presented ten new examples.

Some of these mimicking fishes are either imitating animals that are actively avoided by predators due to venomous or noxious qualities or are protected from predation by some benefit they bestow (such as cleaners). Many predaceous mimics resemble nonpredatory fishes or ones that feed on different prey animals, thus giving them the opportunity to get closer to their prey.

The explanation we offer for the mimicry of *Mulloidichthys mimicus* for *Lutjanus kasmira* is somewhat different. We believe that goatfishes are preferred as food by predaceous fishes, in general, to snappers of the genus *Lutjanus*. Goatfishes are softer bodied, have very finely ctenoid scales and flexible spines. The firmer-bodied *Lutjanus* spp. have more coarsely ctenoid scales and relatively stout spines in the dorsal and anal fins. Also they are deeper-bodied. Because they are stronger fishes, snappers undoubtedly escape from a predator more readily than goatfishes when not well seized. More important, however, than being less delectable is the difficulty diurnal reef piscivores must experience trying to capture the species of *Lutjanus*. These snappers are primarily nocturnal. They tend to stay close to shelter during the day. In our opinion they are among the more intelligent of fishes, judging by their ability to learn to avoid man when he becomes an underwater predator (*i.e.* spearfisherman). Goatfishes, on the other hand, expose themselves more to predation than snappers; they feed mainly on open bottoms, even if just a sand patch in a reef. Furthermore they are far less wary than lutjanids.

Through experience reef piscivores learn to avoid the wary fishes that quickly retire to cover in the reef when a dangerous animal approaches. The predators no doubt recognize these difficult species by their configuration and color patterns and turn their attention to casier prey. Therefore *M. mimicus*, with its close resemblance to *L. kasmira*, is probably confused part of the time as *L. kasmira* by its enemies and as a result enjoys some freedom from predation.

If one examines a fresh specimen or photograph of an individual *M. mimicus* and compares it with an individual *L. kasmira*, one can quickly distinguish the two by the deeper body and less forked tail of the snapper and its more oblique upper blue stripes. Another obvious difference is the possession of a pair of barbels on the chin by mullids, but these are usually not seen except when employed during feeding or the search for food (also, courting male mullids may extend and vibrate their barbels, and during cleaning the barbels may be exposed).

In a milling aggregation of the model and mimic, however, it is very difficult to pick out individual goatfish from the snappers. As mentioned, the *M. mimicus* were of about the same size as the *L. kasmira* in the mixed schools. No observations were made of solitary *M. mimicus* in the Line Islands or Marquesas. In fact, this species was only seen in more or less stationary aggregations with *L. kasmira*. It was not observed to feed. Possibly it is mainly nocturnal like *M. vanicolensis* and *M. flavolineatus*. If so, it probably feeds individually at night.

One of the examples of mimicry given by RANDALL and RANDALL (1960) was that of the young of the surgeonfish *Acanthurus pyroferus* and the angelfish *Centropyge flavissimus*. These authors were confident that mimicry was involved and regarded *A. pyroferus* as the mimic. However, they were unable to provide an explanation of the basis for the mimicry at that time. They now believe, however, that a comparable explanation may be given to that just presented for *M. mimicus* and *L. kasmira*. Through experience in

trying to collect individual *Centropyge flavissimus* and other species of this genus or trying to photograph them at close range underwater, the senior author has learned that they are extremely wary. These little angelfishes have a restricted home range in coral reef or rubble areas which is replete with hiding places to which they quickly retire when frightened (often to reappear at some other point when they emerge from cover). Surely the reef piscivores learn the same behavior of this genus, and as postulated for lutjanids, they may regard the *Centropyge* as well as fishes of the same shape and color pattern as not worth the effort to try to capture them. The surgeonfishes of the genus *Acanthurus* are less wary, range more widely in their quest for algal food, and do not remain so close to shelter. They are often found in the stomachs of piscivores. The juvenile of *Acanthurus pyroferus*, by its remarkable resemblance to the *Centropyge*, not only in the complex color pattern but in having a rounded caudal fin, is probably ignored much of the time by predators. This mimicry is even more striking when it is realized that juveniles of *A. pyroferus* mimic other *Centropyge* in different parts of the surgeonfish's range. In the western Pacific where *C. flavissimus* is rare or absent, it mimics mainly *C. vrolicki*, and in the eastern Indian Ocean principally *C. eibli*.

LITERATURE CITED

- FOWLER, Henry W., 1927. — Fishes of the tropical central Pacific. *Bull. B. P. Bishop Mus.*, **38** : 1-32, 1 pl., 6 text-figs.
- 1928. — The Fishes of Oceania. *Mem. B. P. Bishop Mus.* **10** : iii + 540 p., 49 pls., 82 text-figs.
- HERRE, Albert W., 1936. — Fishes of the Crane Pacific Expedition. *Fld Mus. nat. Hist., Zool. Ser.*, **21** : 1-472, 50 figs.
- RANDALL, John E., 1978. — Marine biological and archaeological expedition to southeast Oceania. *Natn. geogr. Soc. Res. Rep.*, **1969** Projects : 473-495, 6 figs.
- RANDALL, John E., and Helen A. RANDALL, 1960. — Examples of mimicry and protective resemblance in tropical marine fishes. *Bull. mar. Sci. Gulf Caribb.*, **10** : 444-480, 15 figs.
- RUSSELL, Barry C., Gerald R. ALLEN and H. Roger LUBBOCK, 1976. — New cases of mimicry in marine fishes. *Jour. zool. Res.*, **180** : 407-423, 9 pls.
- SCHULTZ, Leonard P., and collaborators, 1960. — Fishes of the Marshall and Marianas Islands. *Bull. U. S. natn. Mus.*, **202** : ix + 438 p., 49 pls., 42 text-figs.

Manuscrit déposé le 10 octobre 1979.



